$1.00

Simpson

INSTRUMENTS THAT STAY ACCURATE

# OPERATOR'S MANUAL

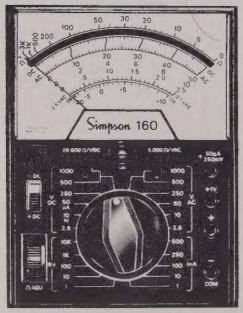
**WARNING**

**For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.**

## VACUUM TUBE VOLT-OHMMETER
## MODEL 312

SIMPSON ELECTRIC COMPANY
853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 695-1121
In Canada, Bach-Simpson, Ltd., London, Ontario

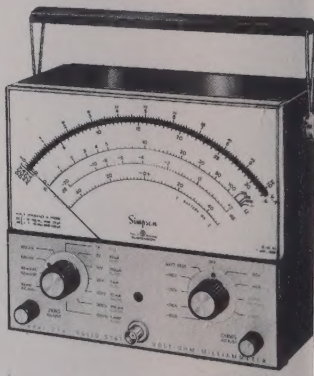
# new VOMs from Simpson




## 160 Handi-VOM

**Just 3 5/16" Wide . . .**
**with Full-Size VOM Features**

- 20,000 Ω VDC . . . 5,000 Ω VAC
- ±2% DC . . . ±3% AC
- 5 Resistance Ranges . . . Plus a 0-250 DC Millivolt Range



## 314 Solid-State VOM

**VTVM Features . . . VOM Conveniences**

- 10mVAC, 50mVDC ranges
- Low power and conventional ohms
- Frequency compensated, 100 MegΩprobe
- Large 7" scale
- Battery Operated

*Write for Catalog 4300*

---

**Simpson has over 1,400 stock sizes and types of panel instruments, too!**

*Write for Catalog 4300*

# OPERATOR'S MANUAL

## VACUUM TUBE VOLT-OHMMETER
## MODEL 312

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853 Dundee Ave., Elgin, Illinois 60120
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SIMPSON ELECTRIC CO., CHICAGO
10-72 OMO HINZ

Printed in U.S.A.
5-110065

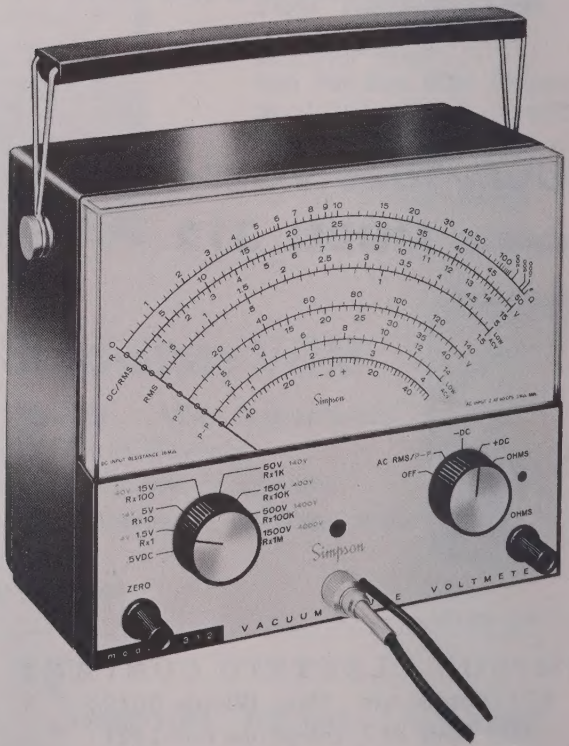


FIGURE 1. SIMPSON VACUUM TUBE VOLTMETER MODEL 312

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# SECTION I

# SPECIFICATIONS

| D.C. VOLTAGE | Accuracy in % of full scale |
|---|---|
| 8 Ranges: 0-0.5-1.5-5-15-50-150-500-1500 volts (16 megohm-input impedance) | 3 |

| A.C. VOLTAGE | |
|---|---|
| 7 Ranges: 0-1.5-5-15-50-150-500-1500 volts rms (1 megohm minimum input impedance) | 3 |
| 7 Ranges: 0-4-14-40-140-400-1400-4000 volts peak to peak | 3 |

| RESISTANCE | | Accuracy in degrees of arc |
|---|---|---|
| 7 Ranges: | Rx1 for 0-1000 ohms (10 ohm center) | 3 |
| | Rx10 for 0-10,000 ohms (100 ohm center) | 3 |
| | Rx100 for 0-100,000 ohms (1,000 ohm center) | 3 |
| | Rx1K for 0-1 megohm (10,000 ohm center) | 3 |
| | Rx10K for 0-10 megohms (100,000 ohm center) | 3 |
| | Rx100K for 0-100 megohms (1 megohm center) | 3 |
| | Rx1M for 0-1,000 megohms (10 megohm center) | 3 |

## INPUT RESISTANCE

All DC ranges (with switch on Probe No. 0150 set to "DC") 16 megohms

AC Ranges (with switch on Probe No. 0150 set to "AC/OHMS"):

| | |
|---|---|
| 1.5, 5, 15, 50, 150 volt ranges | 1 megohm (minimum) |
| 500 volt range | 1.4 megohms (minimum) |
| 1500 volt range | 1.5 megohms (minimum) |

## FREQUENCY RESPONSE

AC Voltage measurements with the switch on Probe No. 0150 set to "AC/OHMS".

1.5, 5, 15, 50, 150 volt ranges:

for source impedance of
100 ohms about 10% up at 4 megahertz

for source impedance of
200 ohms essentially flat to 3 MHZ

for source impedance of
200 ohms about 10% down at 5 MHZ

for source impedance of
600 ohms about 10% down at 1 MHZ

for source impedance of
1,000 ohms about 10% down at 0.7 MHZ

Low frequency end: 3% down at 15 hertz
about 10% down at 5 hertz

500 volt range: essentially flat from 15 Hertz to 100 Kilohertz

1500 volt range: flat at power line frequencies

AC voltage measurements by using R.F. probe No. 0152 (available on separate order).

up to 40 volts rms for sine waves within 1db from 10 Kilohertz to 250 Megahertz

## MAXIMUM INPUT VOLTAGES

| | |
|---|---|
| DC Voltages with no ac voltage present: | 1500 Volts |
| AC Voltages with no dc voltage present: | |
| RMS for sine wave | 1500 Volts |
| Peak to Peak for sine wave | 4200 Volts |
| Sum of DC Voltage and AC Peak Voltage | 1750 Volts |

For measuring higher than 1500 volts DC, see information on High Voltage accessory probe on page 30.

## POWER SUPPLY

| | |
|---|---|
| Line Voltage | 105-125 volts * |
| Line Frequency | 50-60 Hertz/sec. |
| Power Consumption | 7 watts |
| Battery, Eveready No. 935, or equivalent | 1.5 volt cell |

* Export model is made for operation at 200-240 volts.

| OVER-ALL DIMENSIONS | WEIGHT |
|---|---|
| 7-3/4" x 6-3/4" x 3-3/4" | 4-3/4 lbs. |

# SECTION II

# GENERAL DESCRIPTION

The Simpson Model 312 is an uniquely styled vacuum tube voltmeter with excellent electrical properties. The unusually long scale length provides a tester of maximum readability and accuracy. It uses a highly shock resistant self-shielding, annular type meter which eliminates errors normally caused by stray currents and magnetic materials. The high input resistance and very good frequency response of the Model 312 extends its usefulness for measurement of electrical characteristics of DC and AC circuits as well as circuit components.

One additional low DC voltage range enables the Model 312 to be used for accurate measurements below 0.5 volt levels. Most of the high quality components are assembled on a printed circuit board to achieve uniformity, simplified assembly, and minimum maintenance. The tester is housed in a black phenolic case that is designed with an Adjust-A-Vue type handle. All component parts in the tester are attached to a metal chassis mounted along the meter base. The entire tester slips into and out of the case in one piece.

## RANGE SELECTOR SWITCH

The range switch is located on the lower left side, and has eight positions. There are eight voltage ranges for DC, seven for AC rms and seven for AC peak-to-peak measurements. There are also seven ranges for resistance measurements.

## CIRCUIT SELECTOR SWITCH

The circuit selector switch on the lower right side has five positions: OFF, AC, −DC, +DC, and OHMS.
When DC voltage is measured, the circuit selector switch may be set at −DC or +DC, depending on the polarity of the voltage to be measured.

## ZERO CONTROL

The control at the lower left is marked ZERO and is used to set the instrument indication on the zero mark with the power turned on, before the voltage or resistance to be measured is applied to the tester input. Checking and readjusting for correct zero indication after changing the range or function switch positions will ensure accurate readings at all times. In cases when the Model 312 is operated as a center zero meter on any of the +DC ranges, the zero control is

used to set the pointer indication to the center scale zero mark. (see page 11)

## OHMS CONTROL

The control located at the lower right is marked OHMS. It is used to set the pointer indication on the full scale mark "∞" before a resistance measurement is made.

## INPUT CONNECTOR

For convenience, the Model 312 has only one input connector. This screw-on type coaxial receptacle accepts a cable plug used on probes available for use with the Model 312.

The center contact of the receptacle connects the input circuit of the Model 312 to the inner conductor of the coaxial probe cable. The body of the receptacle is grounded to the chassis and connects the probe cable shield through a cable plug to the chassis of the Model 312.

## GROUND LEAD

A four foot long rubber insulated lead is terminated at one end with an alligator clip while the other end is connected permanently to the chassis. This lead functions as a common test lead for checking AC and DC voltages or as a negative polarity lead for resistance measurements.

## METER ZERO ADJUST (MECHANICAL)

The meter zero adjust knob in the center below the dial has a screwdriver slot and is used for adjusting the meter pointer for zero before the power to the Model 312 is turned on.

## PILOT LIGHT

The pilot light is mounted on the chassis below the meter

cover. A glow can be seen through a round hole in the cover overlay when the power is "ON".

### ADJUST-A-VUE HANDLE

A black plastic molded handle is attached to each side of the case with chrome plated holders and studs. The handle may be used to support the instrument in a convenient sloping position for easy viewing on the bench top. The tester can also be used in either a vertical or horizontal position.

### POWER CORD

The power cord contains 3 conductors and is terminated at one end with a three prong plug. On the tester side the green colored conductor is connected to the chassis of the Model 312. As long as the cable is not damaged and the tester is powered from a correctly grounded three wire line, the chassis and the ground test lead will always be at ground potential. In case of component fracture or inadvertent connection of the ground test lead to a "hot" line, the chassis ground connection (through the grounded plug) will preclude any operator safety hazard.

## SECTION III

## OPERATING INSTRUCTIONS

**CAUTION**

Be extremely careful when working in high voltage circuits. Do not touch the instrument or test leads while power is on in the circuit being measured.

### METER ZERO ADJUSTMENT (MECHANICAL)

Before turning on the power in the Model 312, check to see

that the pointer indicates zero when the tester is in its operating position. If the pointer is off zero, adjust the slotted screw located on the front panel. Use a screwdriver to turn this screw slowly clockwise, or counter-clockwise, until the pointer is directly over the zero point on the scale.

## TESTER ZERO ADJUSTMENT (ELECTRICAL)

After the power has been turned on by setting the circuit selector switch for the function desired, the knob marked ZERO should be turned either clockwise or counter-clockwise until the meter pointer rests over the zero marks at the left side of the scale. Connect the probe and ground lead together while making this adjustment. It may be necessary to re-adjust for zero when changing positions of circuit or range-selector switches. To eliminate zero readjustment when changing AC voltage ranges, use the lowest AC range for adjusting zero indication.

## MEASURING DC VOLTAGES

Note: See CAUTION notice on page 9.

1. Place the circuit selector switch in the −DC or +DC position, depending on the polarity of the voltage to be measured.
2. Rotate the range switch to select the full scale range desired. While the Model 312 circuits will not be easily damaged, it is best to set the range switch for a higher range than needed as a protection to the balance tube and the meter movement. After the first reading, set the range switch for a lower range if necessary to provide a more accurate reading.
3. Connect the crocodile clip of the ground test lead to the reference point for the voltage to be measured.

4. Set the switch on the probe handle at "DC." Connect the probe tip to the point to be measured.
5. Observe the meter reading. If the meter pointer deflects to the left, circuit polarity is opposite to that for which the circuit selector switch is set; set the circuit selector switch for the correct polarity.
6. Read the meter scale indication at the pointer position on one of the black arcs. For the .5, 5, 50, and 500 volt ranges use the arc marked from 0 to 50. For the 1.5, 15, 150, and 1500 volt ranges, use the arc marked from 0 to 15.

NOTE: To measure more than 1500 volts DC, see information on High Voltage accessory probe in Section VI.

## ZERO CENTER DC VOLTAGES

1. Set circuit selector switch at +DC. Set the switch on the probe handle at DC and short the test leads together.
2. Rotate the ZERO control knob until the meter pointer rests over the zero center mark.
3. Set the range selector switch to a range which is at least twice the probable voltage to be measured. Connect the test leads to the circuit the same as for DC voltage measurements.
4. Observe the meter pointer indication on the arc marked DC/RMS. Positive voltages will be indicated above the center mark; negative voltages will be indicated to the left. Each side of the scale represents one-half of the range being used. For example, when the 50 volt range is being used, each half of the scale represents 25 volts and each division 1 volt.

The purposes for which the zero center scale is used usu-

ally do not require an accurate measurement of the quantity of voltages, but merely an indication of a balanced condition. An example is alignment of an FM discriminator; the desired balanced condition will result in a zero center indication; while a misaligned condition will cause some deflection away from the zero center.

## MEASURING AC VOLTAGES EFFECT OF WAVEFORM

The Model 312 Vacuum Tube Voltmeter is calibrated using a sinusoidal signal. The circuitry is such that it is considered a peak-to-peak voltage reading type. Since this is the case, the AC scales are calibrated using effective values based on true sine waves. When it is known that other than sinusoidal signals are being measured, it must be recognized that the accuracy as specified for sinusoidal input will not apply.

## MEASURING AC VOLTAGES, RMS AND PEAK TO PEAK

NOTE: See CAUTION notice on page 13.

1. Place the circuit selector switch in the AC position.
2. Set the range switch in the desired range position.
3. Connect the clip of the ground test lead to the chassis or reference point in the circuit to be measured.
4. Set the switch on the probe handle at AC/OHMS. Connect the probe tip to the point in the circuit where voltage is to be measured.
5. Observe the meter readings. The pointer indicates voltages on two arcs for AC measurements; R.M.S. and peak-to-peak. Both values apply when the input waveshape being measured is a sine wave. Only the peak-to-peak value applies when the input waveshape is not a sine wave.

| For Range Switch Position Black/Red | Read R.M.S. Voltages on Black arc marked: | Read Peak-to-Peak Voltages on Red arc marked: |
|---|---|---|
| 1.5V/4V | 0-1.5 Low ACV | 0-4 Low ACV |
| 5V/14V | 0-5 Low ACV | 0-14 Low ACV |
| 15V/40V | 0-15V | 0-40V |
| 50V/140V | 0-50V | 0-140V |
| 150V/400V | 0-15V (x10) | 0-40V (x10) |
| 500V/1400V | 0-50V (x10) | 0-140V (x10) |
| 1500V/4000V | 0-15V (x100) | 0-40V (x100) |

CAUTION

When making measurements on line powered circuits, check the circuit ground to be sure it is isolated from the line ground. If it is not, orient the circuit ground such that the circuit ground is at the same potential as line ground.

NEVER TOUCH A TEST POINT AT POWER LINE POTENTIAL WITH THE GROUND TEST LEAD OF THE MODEL 312.

In cases where the polarity of the test leads and power line are not orientated correctly, the line fuse will "blow". This will preclude any potential difference between the ground and the Model 312 chassis, thus protecting the operator's safety.

For tests of line voltages the use of a conventional non-line powered VOM such as the Simpson 260 is preferable and recommended.

## MEASURING RESISTANCES

1. Place the circuit selector switch in the position marked

OHMS.

2. Set the range selector switch to the range desired.
3. Set the switch on the probe handle to AC/OHMS.
4. Short the probe tip and the ground lead clip together and check the meter pointer for a zero indication. If necessary, rotate the ZERO control to obtain a zero indication.
5. Separate the probe and ground test lead. The meter pointer should deflect to full scale. Set the OHMS control for exactly full scale deflection. When the pointer cannot be brought up to full scale indication, the battery inside the case needs replacement; see information in Section IV, Maintenance.
6. Be sure no voltage is present in the circuit in which resistance is to be measured. Turn off circuit power and discharge all capacitors.
7. Connect the probe and the ground lead clip to the two points between which DC resistance is to be measured.
8. Read the pointer indication on the upper arc marked R. Multiply the reading by the value indicated at the range switch position. K stands for 1,000. M stands for 1,000,000. The result will be resistance in ohms.

| For Range Switch Position: | | Read Indication in Ohms |
|---|---|---|
| Rx1 | (0 to 1,000 ohm range) | 0-1,000 directly |
| Rx10 | (2 to 10,000 ohm range) | Multiply by 10 |
| Rx100 | (20 to 100,000 ohm range) | Multiply by 100 |
| Rx1K | (200 to 1,000,000 ohm range) | Multiply by 1,000 |
| Rx10K | (2,000 to 10,000,000 ohm range) | Multiply by 10,000 |
| Rx100K | (20,000 to 100,000,000 ohm range) | Multiply by 100,000 |

Rx1M (200,000 to 1,000,000,000 ohm range) Multiply by 1,000,000

On all resistance ranges of the Model 312 the probe tip has "plus" polarity in reference to the ground test lead. This may be an important fact to be considered when checking components which have a "forward" and "backward" resistance such as semiconductors.

## SECTION IV

## MAINTENANCE

### CARE

The Model 312 is a durable and rugged instrument designed to withstand every day service work. Nevertheless, it should receive the care given to other fine electronic equipment. Protect it from shock or other excessively rough treatment.

### TRANSIT SETTING

When the instrument is not in use set the function selector switch to the "OFF" position. For this position a shunt is placed across the meter to damp the movement. It reduces the amount and speed of pointer swing when the instrument is carried or shipped from one place to another.

### REMOVAL FROM CASE

The case of the Simpson Vacuum Tube Volt-Ohmmeter Model 312 has been designed to provide easy and quick access to the inside for replacement of parts and necessary adjustment. Use a screwdriver to remove the four screws through the rear of the case. Then slip the entire front panel straight forward out of the case. The meter, the chassis, the printed circuit, line cord and the ohm range battery are all attached together and will come out as a unit.

## BATTERY REPLACEMENT

One 1.5 volt dry cell battery inside the tester is used to supply current for resistance measurements. When it is no longer possible to bring the pointer indication to full scale for any of the resistance ranges, open the case, remove the old battery and slip a new 1.5 volt size C battery into the battery holding clamp.

Place the battery's "+" contact in direction to the holder spring containing an insulated contact and soldering lug with a lead. When viewing the tester assembly from the rear the plus terminal lies on the right hand end of the battery holder.

## REPLACEMENT OF TUBES

The 6AL5 tube is used as a rectifier for AC voltages. The 12AU7 tube is used in the bridge circuit for all measurements. Each of these two tubes has been pre-aged for 40 hours before installation in the unit. The aged tubes assure tester accuracy for long periods after the unit has been calibrated. An aged 12AU7 reduces the necessity of re-adjusting the zero control for correct zero indication after changing ranges. When replacing a tube it is advisable to use a tube which has been aged by operating it at rated filament voltage and with plate current of approximately 15ma rms per section.

A 12AU7 can be aged by applying 117 Volts AC line voltage directly between plate and cathode with control grid connected to the cathode. For aging of the 6AL5 a low AC voltage as used for the filament (approximately 6 volts) can be applied between the plate and cathode of the diode.

After replacing the 6AL5 the equivalence of zero indication between DC and AC ranges should be checked, and if necessary AC zero (R34) re-adjusted as described under Calibration. After replacing the 12AU7, the accuracy of the volt ranges could be affected. Recheck and recalibrate if necessary.

## CALIBRATION

After a long period of use, or when tubes or other circuit components have been replaced, recalibration may be required. Refer to Figure 2, and use the following procedure for recalibration:

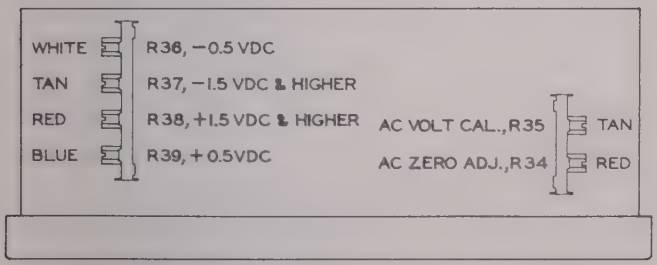



FIGURE 2. LOCATIONS OF CALIBRATING CONTROLS

(Model 312/Top View of the Printed Circuit Board)

Note #1: Before recalibration of AC or DC ranges set the range switch to 1.5 V, the circuit selector switch to AC and allow the instrument to warm up for approximately 1 hour.

Note #2: Calibrate the Model 312 at 117V 60 hertz line voltage. (Export model should be calibrated at 220V/50 hertz line voltage.)

## AC VOLTS, RECALIBRATION

1. Place the probe switch on AC/OHMS.
2. Set the range switch to 1.5 V.
3. Short the probe input.
4. Adjust the zero control located on the front panel so that there is no movement of the pointer when changing circuit selector switch from +DC to −DC or reverse.
5. Leave zero control in that position, set the circuit selector switch to AC and adjust R34 (red knob of two sectional resistor trimmer) until the meter pointer indicates again the same reading as before during alternating between +DC and −DC positions.
6. Set the range switch to 50V.
7. Apply a known sine wave voltage within the limit of range selected to the probe and ground lead.
8. Adjust calibrating control R35 (tan knob of two sectional resistor trimmer) until the meter indicates the calibrating voltage correctly.

## DC VOLTS, RECALIBRATION

Calibrate +0.5V DC or −0.5V DC range before calibrating a higher range on +DC or −DC volt ranges respectively. The setting of the 0.5V DC calibrating control also determines the setting of higher DC volt calibration controls.

Before calibration of any of the DC volt ranges, set the switch on the probe handle to DC, connect the probe tip to the ground test lead and adjust the front panel zero control until the meter pointer indicates zero.

1. Set the range switch to 0.5V DC and the circuit selector switch to corresponding (+ or −) DC polarity. Apply a known DC voltage (0.5 volt or less) to the probe input

and adjust the calibration control until the meter correctly indicates the calibrating voltage;

Adjust R39 (blue knob) when calibrating the +0.5VDC range.

Adjust R36 (white knob) when calibrating the −0.5VDC range.

2. Set the range switch to 1.5V and circuit selector switch to + or −DC polarity as required.

Apply a known DC voltage (1.5 volt or less) to the probe input and adjust the calibration control for correct indication of the calibrating voltage;

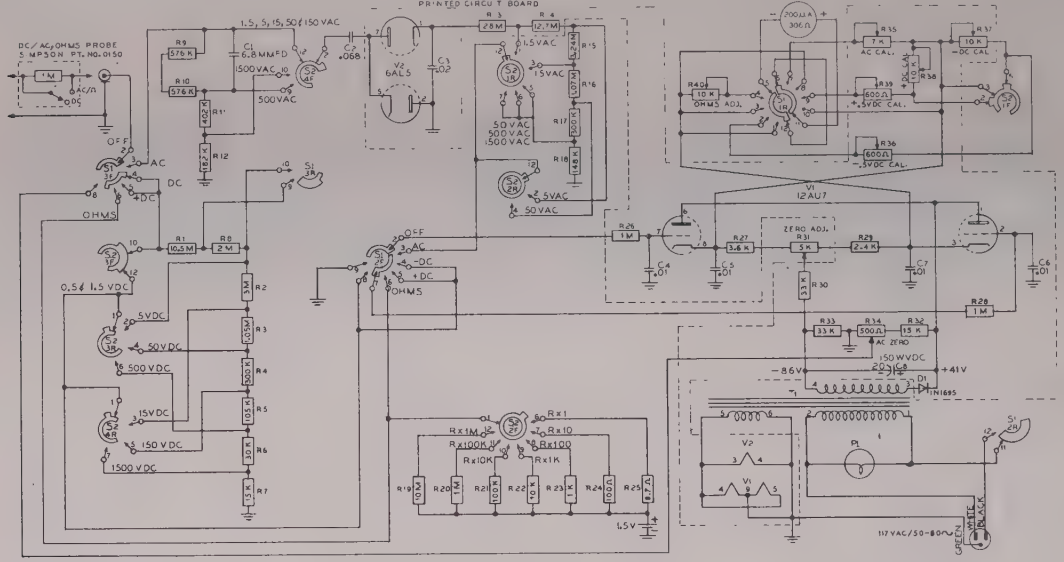
Adjust R38 (red knob/4 sectional trimmer) when calibrating +1.5V (or a higher) DC range.

Adjust R37 (tan knob/4 sectional trimmer) when calibrating −1.5V (or a higher) DC range.

Instead of the 1.5V range a range of 5V, 15V, 50V or 150V can be used in accordance with the calibrating voltage selected. Corresponding voltage which allows the calibration at the point close to the full scale indication should be used whenever it is available.

## REPAIR OR PARTS REPLACEMENT

A list of authorized repair stations and Parts Depots is shown in the rear of the manual. Contact your nearest Repair Station to obtain service or repair for your instrument. If you wish to order a replacement part, use the Simpson part number and send the order to your nearest Parts Depot.




NOTES:

K = 1000 OHMS
M = 1,000,000 OHMS
LAST RESISTOR IS R40
LAST CAPACITOR IS C8
LAST DIODE IS D1
LAST TRANSFORMER IS T1
LAST PILOT LIGHT IS PL
LAST TUBE IS V2

RESISTORS: R34, R35, R36, R37, R38 & R39 ARE ¼ WATT.
RESISTORS: R1, R9, R10, R13 & R14 ARE 1 WATT.
ALL OTHER RESISTORS ARE ½ WATT.
R34 & R35 PACKAGED AS ONE UNIT:
R34 - RED KNOB
R35 - TAN KNOB
R36, R37, R38 & R39 PACKAGED AS ONE UNIT:
R36 WHITE KNOB
R37 TAN KNOB
R38 RED KNOB
R39 - BLUE KNOB

BOTH SWITCHES "S1" (3-SECTIONS, 5-POSITIONS) AND "S2" (4-SECTIONS, 8-POSITIONS) ARE SHOWN IN COUNTERCLOCKWISE POSITION; S1 IN "OFF" AND S2 IN "0.5VDC" POSITION.

ALL CAPACITANCES IN MFD UNLESS OTHERWISE NOTED.

FIGURE 3. SCHEMATIC DIAGRAM, SIMPSON VTVM MODEL 312

## PARTS LIST

| Reference Symbol | Description | Simpson Part No. |
|---|---|---|
| R1 | Resistor, 10.5 megohms 1%, 1W | 5-110038 |
| R2 | Resistor, 3 megohms, 1%, 1/2W | 1-113432 |
| R3 | Resistor, 1.05 megohms, 1%, 1/2W | 1-116680 |
| R4 | Resistor, 300K ohms, 1%, 1/2W | 1-113995 |
| R5 | Resistor, 105K ohms, 1%, 1/2W | 1-116681 |
| R6 | Resistor, 30K ohms, 1%, 1/2W | 1-115042 |
| R7 | Resistor, 15K ohms 1%, 1/2W | 1-113347 |
| R8 | Resistor, 2 megohms, 5%, 1/2W | 5-110035 |
| R9 | Resistor, 576K ohms, 1%, 1W | 5-110056 |
| R10 | Resistor, 576K ohms, 1%, 1W | 5-110056 |
| R11 | Resistor, 402K ohms, 1%, 1/2W | 5-110055 |
| R12 | Resistor, 182K ohms, 1%, 1/2W | 5-110054 |
| R13 | Resistor, 28 megohms, 1%, 1W | 5-110036 |
| R14 | Resistor, 12.7 megohms, 1%, 1W | 5-110037 |
| R15 | Resistor 3.24 megohms, 1%, 1/2W | 5-110053 |
| R16 | Resistor, 1.07 megohms, 1%, 1/2W | 5-110052 |
| R17 | Resistor, 300K ohms, 1%, 1/2W | 1-113995 |
| R18 | Resistor, 148K ohms, 1%, 1/2W | 5-110050 |
| R19 | Resistor, 10 megohms, 1%, 1/2W | 1-113434 |
| R20 | Resistor, 1 megohm, 1%, 1/2W | 1-113392 |
| R21 | Resistor, 100K ohms, 1%, 1/2W | 1-113427 |
| R22 | Resistor, 10K ohms, 1%, 1/2W | 1-115077 |
| R23 | Resistor, 1K ohm, 1%, 1/2W | 1-113542 |
| R24 | Resistor, 100 ohms, 1%, 1/2W | 1-114091 |
| R25 | Resistor, 8.7 ohms, ½%, bobbin | 10-675279 |
| R26 | Resistor, 1 megohm, 10%, 1/2W | 1-113952 |
| R27 | Resistor, 3.6K ohms, 5%, 1/2W | 5-110034 |
| R28 | Resistor, 1 megohm, 10%, 1/2W | 1-113952 |

## PARTS LIST

| Reference Symbol | Description | Simpson Part No. |
|---|---|---|
| R29 | Resistor, 2.4K ohms, 5%, 1/2W | 1-118198 |
| R30 | Resistor, 33K ohms, 5%, 1/2W | 1-115949 |
| R31 | Potentiometer, 5K ohms, +30%/−10%, 1/2W | 5-110018 |
| R32 | Resistor, 15K ohms, 5%, 1/2W | 1-117530 |
| R33 | Resistor, 33K ohms, 5%, 1/2W | 1-115949 |
| R34 | Potentiometer, 500 ohms, ±20%, 1/4W | Packaged as one Unit under part # 5-110032 |
| R35 | Potentiometer, 7K ohms, ±30%, 1/4W | |
| R36 | Potentiometer, 600 ohms, ±30%, 1/4W | Packaged as one Unit under part # 5-110033 |
| R37 | Potentiometer, 10K ohms, ±30%, 1/4W | |
| R38 | Potentiometer, 10K ohms, ±30%, 1/4W | |
| R39 | Potentiometer, 600 ohms, ±30%, 1/4W | |
| R40 | Potentiometer, 10K ohms, ±30%, 1/2W | 5-110019 |
| C1 | Capacitor, 6.8 μμf, ±5%, 1000V, ceramic | 5-110057 |
| C2 | Capacitor, .068 μf, ±10%, 1000v, paper | 1-117475 |
| C3 | Capacitor, .02 μf, ±5%, 400V, paper | 1-116411 |
| C4 | Capacitor, .01 μf, MRC, 500V, ceramic | 1-114872 |
| C5 | Capacitor, .01 μf, MRC, 500V, ceramic | 1-114872 |
| C6 | Capacitor, .01 μf, MRC, 500V, ceramic | 1-114872 |
| C7 | Capacitor, .01 μf, MRC, 500V, ceramic | 1-114872 |

## PARTS LIST

| Reference Symbol | Description | Simpson Part No. |
|---|---|---|
| C8 | Capacitor, .20 μf, +100%/-10%, 150V, electrolytic, dry | 1-114105 |
| D1 | Diode, silicon, type 1N1695 | 5-110016 |
| S1 | Switch, 3 sections, 5 positions | 5-110020 |
| S2 | Switch, 4 sections, 8 positions | 5-110021 |
| T1 | Power transformer, 117V/50-60 hertz (domestic) | 5-110017 |
| | Power transformer, 220V/50-60 hertz (export version) | 5-110243 |
| | Resistor, 39K ± 5%, 1/2 Watt (series resistor for pilot light used in export model only) | 1-111604 |
| P1 | Pilot light with speed nut | 1-110615 |
| | Line cord with 3 prong plug | 1-110614 |
| | Cable clamp, nylon | 1-110208 |
| V1 | Tube, 12AU7, aged | 3-310744 |
| | Tube socket, 9 pins | 5-110015 |
| V2 | Tube, 6AL5, aged | 3-811288 |
| | Tube socket, 7 pins | 5-110014 |
| | Phenolic case | 3-320285 |
| | Carrying handle assembly (less hardware) | 10-861080 |
| | Knobs for switches (less set screws) | 5-110063 |
| | Set screws (for knobs 5-110063) | 5-110242 |
| | Knob, push-on type, for controls | 5-110064 |
| | Meter Assembly | 15-302312 |
| | Common test lead (ground lead) ass'y | 10-830149 |
| | DC, AC/OHMS Probe #0150 | 10-830150 |

## SECTION V

## APPLICATIONS

The high input resistance and wide frequency range of the Simpson Vacuum Tube Voltmeter Model 312, permits it to be used in many applications where a voltmeter of lower sensitivity or narrower frequency range would result in excessive circuit loading. DC voltages as low as a few millivolts can be measured accurately due to the sensitive bridge circuit with the 0.5 volt range. Resistances of conductors as well as insulators can be measured on the 7 resistance ranges contained in the Model 312. The following suggestions are only a few of the uses for which the Simpson Model 312 will be found to be a superior instrument.

### MEASURING LOW CATHODE AND TRANSISTOR BASE/EMITTER VOLTAGES

Bias voltages of input stages, I. F. amplifiers, special types of feedback amplifiers and transistorized circuits are usually low. The low DC ranges of the Model 312 permits accurate measurements of these low voltages.

### MEASURING PLATE VOLTAGES

Inaccurate readings of plate voltage often result when a low resistance voltmeter is used, especially in the case of tube circuits employing high value plate resistors. Such voltages can be accurately measured with the Simpson Model 312 because its very high input resistance on all DC ranges will have negligible loading effect.

### PHASE INVERTER BALANCE

The two sections of a phase inverter circuit may be checked for balance with the Simpson Model 312. With an audio sig-

nal generator connected to the input of the audio amplifier, the voltages at the grids and plates may be measured. Similarly, the plate and cathode output voltages of a phase splitter circuit can be measured and compared.

## MEASURING STAGE GAIN

The Model 312 is suited for measuring amplifier stage gain. Apply the output of a signal generator to the amplifier input, measure and compare the input and output signal for each stage or complete amplifier. The ratio of voltage between the output and the input, represents the stage gain or overall gain respectively.

When checking the output signal in a plate circuit with a high load resistor, it is recommended that a capacitor of approximately 0.05$\mu$f be connected between the point under test and the probe tip of the Model 312. This capacitor will block the DC component of the signal and allow the AC signal only to be connected to the input of the instrument, thereby reducing the loading effect on the circuit under test.

## MEASURING AGC VOLTAGE

Automatic Gain Control circuits develop small voltage values across a high resistance circuit. A low resistance placed in parallel with the AGC circuit will reduce this voltage. For this reason only a voltmeter with a high input resistance can be used to measure the voltage present. The input resistance of the Model 312 is as high as 16 megohms and it may be placed across any such AGC circuit to measure AGC voltages.

## MEASURING OSCILLATOR GRID-BIAS

The negative voltage developed on the grid while an oscillator is operating may be measured with the Model 312 on one of its DC ranges without loading effect on oscillator circuit. A small DC voltage measured on the grid of an oscillator tube is proportional to the amplitude of the oscillation, thus the output of a local oscillator may be checked throughout its tuning range.

## DISCRIMINATOR ADJUSTMENT

The zero center mark on the dial of the Model 312 permits easy adjustment of a discriminator stage. With the probe input connected across the discriminator load resistors and the instrument set up for zero center on a +DC volt range, discriminator balance will be shown when the meter pointer is at the zero center mark. Any unbalance in the discriminator will cause the pointer to be deflected to the right or to the left of the zero center mark.

## FM ALIGNMENT

By connecting the Model 312 across the first limiter grid leak resistor, a reading will be obtained for FM alignment purposes. Adjust the circuits for a maximum indication. Follow the receiver manufacturer's instructions for the exact procedure as it applies to his particular receiver.

## MEASURING NON-SYMMETRICAL WAVE SIGNALS

For trouble shooting in TV receivers or in other devices which contain complex wave forms, the Model 312 is a very useful instrument. The peak-to-peak values of the complex or non-symmetrical waves are usually specified on the TV schematic diagrams and can be checked and read directly on the red scales of the Model 312.

## SIGNAL TRACING

The Model 312 is very useful for signal tracing or for examining a radio circuit at various points in audio or radio frequency circuits. Its low capacity accessory high frequency probe permits its use in high frequency circuits such as are present in FM and TV receivers.

## FORWARD AND REVERSE RECTIFIER RESISTANCES

The resistance of copper oxide, germanium, silicon, selenium, and crystal rectifiers can normally be measured in both directions. However, the resistance should be quite small in one direction (for forward polarity) and very large in the opposite direction. Use the Model 312 ohmmeter circuit to determine that there is a large difference between the resistances in the two directions. If the polarity of a semiconductor must be determined, switch the test leads of the Model 312 to the semiconductor until the lowest resistance indication is obtained. This is then forward polarity of the semiconductor and the electrode to which the probe tip is connected is the anode of the semiconductor. When the resistance of a semiconductor is measured in the backward direction (relatively largest resistance indication), then the electrode to which the probe tip is connected is the cathode of the semiconductor.

## COUPLING AND BY-PASS CAPACITORS

a. In RC coupled circuit one end of the capacitor usually has positive plate potential whereas the other end is connected to the grid of the following tube. To identify leaky coupling capacitor without disconnecting them, place the Model 312 on one of its DC voltage ranges and connect it across the grid resistor. If the voltage

on the socket grid pin is positive remove the tube from the socket. If positive voltage still appears after the tube is removed a leaky coupling capacitor is indicated. But when the positive voltage checked on the socket grid pin disappears after the tube is removed from socket, the source of the positive voltage may be a gassy tube.

b. To identify an open By-Pass or coupling capacitor, set the Model 312 on an AC range and measure the AC voltage at each side of the capacitor in its circuit. When a normal frequency is applied through the circuit, an open capacitor will show a normal or high input voltage, but little or no output voltage. In cases where one lead of the By-Pass capacitor is connected directly to the chassis or ground potential this method to identify an open capacitor can be used also, but after the capacitor lead is disconnected from the chassis.

c. To identify a shorted capacitor, isolate it from its circuit by removing either of its leads. Then set the Model 312 for OHMS measurements on a high range (set on a medium ohm range for checking electrolytics) and measure resistance of the capacitor. The meter will show a sudden drop towards zero when the test leads are first connected to the capacitor. This pointer indication is normal; the current flowing from the ohmmeter circuit starts the charging of the capacitor. The pointer then falls below the full scale indication and its return time is closely proportional to the magnitude of the capacitance. After a while the pointer should return to the scale point of infinite resistance (full scale). Low capacitor resistance indicates poor dielectric insulation

or a shorted capacitor. A resistance reading of an electrolytic capacitor may be only a few hundred kilo-ohms or even less depending on the capacitance value and construction.

When checking electrolytic type capacitors connect the ground lead of the Model 312 to the negative terminal and the probe tip to the positive terminal of the capacitor.

## SECTION VI

## ACCESSORY PROBES

## HIGH FREQUENCY PROBE

### GENERAL DESCRIPTION

| | |
|---|---|
| Frequency Response within 1DB | 10 Kilohertz to 250 Megahertz |
| Probe Input Capacitance | 2 $\mu\mu$f |
| Voltage Range | 110 volts peak-to-peak (maximum) |
| Probe Accuracy | ±3% of full scale |
| Reading | RMS or P-P value of sine wave |
| Maximum Input | Input capacitor rated at 500 volts peak |

The High Frequency Probe, part number 0152, for the Simpson Model 312 is designed primarily to measure voltages, at frequencies above the range of the regular DC, AC/OHMS probe furnished with the tester. The cable terminates with the same type of connecting plug.

The crystal diode contained within the probe body rectifies the voltage under test, charging the 680 $\mu\mu$f capacitor proportional to the positive peak value. This direct current is

then fed through the 7 Meg. resistor and into the DC input of the instrument circuit where it is read directly on the meter scale in RMS or P-P Value.

It is important to note that the probe circuit works as a peak detector and responds only to the positive peak value of the signal under test.

## OPERATING INSTRUCTIONS

Connect the cable plug on the end of the cord to the Model 312 VTVM input connector. Set the circuit selector switch on Model 312 to –DC, and the range switch to the desired range. Connect the probe's ground lead alligator clip to ground adjacent to the point of measurement, and touch the tip of the probe to the point being measured.

Read either RMS or P-P scale on the Model 312 VTVM for the corresponding desired range, while checking sine wave amplitudes. When checking the signals of unsymmetrical wave shapes convert meter reading to positive peak reading by dividing the reading on P-P scale by 2.

## D.C. HIGH VOLTAGE PROBE

### CAUTION

**WHEN MEASURING HIGH VOLTAGES, FIRST TURN OFF POWER IN THE CIRCUIT TO BE MEASURED AND DISCHARGE ALL CAPACITORS. CONNECT THE GROUND TEST LEAD AND THE PROBE TO THE CIRCUIT AND THEN TURN ON CIRCUIT POWER. DO NOT TOUCH PROBE OR LEADS WHILE POWER IS ON. TURN OFF POWER AND DISCHARGE CAPACITORS BEFORE PROBES ARE DISCONNECTED OR MOVED.**

## GENERAL DESCRIPTION

Accessory probe, part number 0155, is available for use in high DC voltage measurements.

The probe body is made of high temperature polystyrene. A shielded cable and internal probe shield are used to protect the operator from any possible flash-over and to ground any electrostatic charges that might accumulate on the probe body. The internal shield and cable shield are connected to chassis ground, through the cable plug to the grounded shell of the Model 312 input connector. The probe has a multiplier resistor which will increase the instrument ranges to 100 times the value marked on the front panel.

| | |
|---|---|
| Accuracy: Probe resistance | ±2% |
| Total input resistance (Probe plus VTVM Model 312) | 1600 Megohms |
| Maximum Voltage allowable | 30,000 Volts D.C. |

## OFERATING INSTRUCTIONS

Take precaution as stated under "CAUTION NOTES" on the instruction sheet of the High Voltage Probe, part number 0155.

Connect the clip of the ground test lead from the Model 312 to the chassis of the circuit to be measured. Connect the cable plug of the high voltage multiplier probe to the input connector of the Model 312. Proceed as for ordinary DC voltage measurements, with ranges equal to 100 times the range switch position marking.

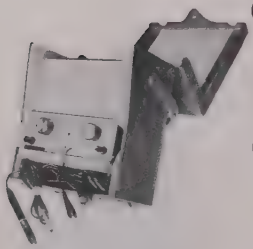
Accessory Probes

| Range Switch Position | Instrument Ranges With Accessory H.V. Probe |
|---|---|
| 0.5 VDC | 0-50 Volts DC |
| 1.5 V | 0-150 Volts DC |
| 5 V | 0-500 Volts DC |
| 15 V | 0-1,500 Volts DC |
| 50 V | 0-5,000 Volts DC |
| 150 V | 0-15,000 Volts DC |
| 500 V | *0-30,000 Volts DC |

*30,000 Volts DC is the maximum allowable voltage for safe operation; do not apply voltages as high as those which would cause the meter indication higher than "30" on the 50V scale while the Range switch is set to 500 V position.

## ACCESSORY PROBES

High Frequency (RF) Probe.....00152
High Voltage (30 kV) Probe.....00151



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